User Manual

TesiMod Hand-held Terminal HT20

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SÜTRON ELECTRONIC GMBH

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1 Important Notes

1.1 Symbols

The symbols in this manual are used to draw your attention on notes and dangers.

1.1.1 General Symbols

Danger
This symbol is used to refer to instructions which, if ignored or not carefully followed could result in personal injury.

Note
This symbol indicates application tips or supplementary notes.

Reference to source of information
This symbol refers to detailed sources of information on the current topic.

1.1.2 Specific Symbols

The following symbols indicate specific dangers which could result in damage to equipment or personal injury or even up to the death of the operator.

Danger - Electric Shock

Danger - Corrosive

Danger - Toxic

Danger - Explosive

Danger - Fire

Danger - Infrared Light

Danger - Electrostatic Charge

1.2 Safety Notes

- Read this manual carefully before using the operating device. Keep this manual in a place where it is always accessible to all users.
- Proper transportation, handling and storage, placement and installation of this product are prerequisites for its subsequent flawless and safe operation.
- This user manual contains the most important information for the safe operation of the device.
- The user manual, in particular the safety notes, must be observed by all personnel working with the device.
- Observe the accident prevention rules and regulations that apply to the operating site.
- Installation and operation must only be carried out by qualified and trained personnel.

1.3 Intended Use

- The device is designed for use in the industry.
- The device is state-of-the art and has been built to the latest standard safety requirements. However, dangerous situations or damage to the machine itself or other property can arise from the use of this device.
- The device fulfills the requirements of the EMC directives and harmonized European standards. Any modifications to the system can influence the EMC behavior.

This is a class A device. This device may cause radio interference in residential areas. In this case, the user may be required to introduce appropriate countermeasures, and to bear the cost of same.

1.4 Target Group

All configuration, programming, installation, commissioning, operating and maintenance work in connection with the automation system must be performed by trained personnel only (e.g. qualified electricians, electrical engineers, etc.).

The configuration and programming personnel must be familiar with the safety concepts of automation technology.

The operating personnel must have been trained in handling the controller and be familiar with the operating instructions.

The installation, commissioning and maintenance personnel must have an education which entitles them to work on automation systems.

2 Design and Commissioning

2.1 Unpacking the Device

Unpack all parts carefully and check the contents for any visible damage in transit. Also check whether the shipment matches the specifications on your delivery note.

If you notice damages in transit or discrepancies, please contact our sales department immediately.

2.2 Design

2.2.1 Front View with Dimensions

Figure 2-1 Front view with dimensions

2.2.2 Side View with Dimensions

Figure 2-2 Side View with Dimensions

2.2.3 Rear View

Figure 2-3 Rear view

1 Housing Screws
2 Consent Switch (Option)
3 Handle Set (Option)
4 Nameplate
5 Flap for Download Interface

2.3 Connecting the Device

The device is equipped with either an open cable end or with an assembled 16 or 19 pin connector.

The 16 pin connector consists of the following components:

Table 2-1 16 pin angle connector

Designation	Part Number
Angle connector or cable connector	7301500000 7101500000
16-pin insert for pins	7003916101
Crimp pin	7010901001

To connect a device with a 16 pin connector, you need a suitable connector which consists of the following components:

Table 2-2 16 pin device connector

Designation	Part Number
Device connector (Front Panel Mounting)	7410000000
16 pin insert with soldering contacts	7001916104

Figure 2-4 16 pin device connector / pin diagram

The listed parts can be obtained from Hummel Metall- und Kunststofftechnik GmbH.The device connector with a suitable insert can be obtained directly from Sütron electronic.

The 19 pin connector consists of the following components:

Table 2-3 19 pin cable connector

Designation	Part Number
Cable connector	TU-1RP1NRA8UAB
For Standard pin assignment: 16 x crimp pin (pin 1 - 5, 7 - 11, 13 - 18) For HMI Linkbox pin assignment: 12 x crimp pin (pin 1 - 5, 10, 11, 13 - 15, 17, 18)	RC-6LP2000
For HMI Linkbox pin assignment: 4 x crimp pin (pin 7, 8, 9, 16)	RC-6NP2000
3 x Crimp pin (pin 6, 12, 19)	RC-6EP2000

To connect a device with a 19 pin connector, you need a suitable connector which consists of the following components:

Table 2-4 19 pin device/coupler connector

Designation	Part Number
Device connector (front panel mounting) or coupler connector	TU-1RS1NRAWB00 TU-1RS1NRA9UAB
16 x crimp female connector (pin 1 - 5, 13 - 18, 19)	RC-6LS2000
3 x crimp female connector (pin 6, 12, 19)	RC-6FS2000

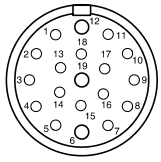


Figure 2-5 Pin diagram for 19 pin connector

The listed parts can be obtained from CONINVERS GmbH. A crimp tool must be used to crimp the crimp pins. This tool can also be obtained from CONINVERS GmbH.

2.4 Connecting the Device

Hazardous voltages can exist inside electrical installations that can pose a danger to humans. There is a risk of electric shock when touching live parts!

For information on the pin or core numbers for the supply voltage, please refer to the chapter "Device Interfaces".

The device is protected against polarity reversal. The device will not operate if the polarity is incorrect.

This device is in Protection Class I. To ensure safe operation, a safety extra-low voltage (SELV) according to DIN EN 61131 must be used for the supply voltage.

2.5 Switching the Device on

After you applied the supply voltage, a system test is carried out during which the modules in the operating device are tested and initialized. All status LEDs are activated for a short time. A number of system and error messages can be output by the system test. If the application memory contains a valid project, the first mask, i.e. the „Start mask“ or the mask defined in the TSwin language parameters as the Start-up mask appears on the display.

The „Start mask“ is displayed for 5 seconds. This is a fixed time setting. After this time has elapsed, the „Main mask“ or the mask defined in the language parameters as the Main mask appears on the display. This is the first mask of the operator guidance.

When you push any button while the „Start mask“ is displayed, the „Setup mask“ appears. In this mask you define the parameters for the interfaces and the operating device.

2.6 Identification

You can identify the operating device by the nameplate on the rear.

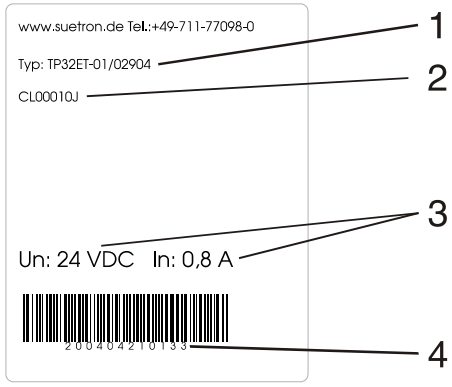


Figure 2-6 Nameplate (example)

1 Order Number
2 Firmware Version (Version on Delivery)
3 Voltage and Current
4 Serial Number

Depending on the size of the display, you will be able to read various types of information as the operating device is initialized: clock frequency, application memory size, current firmware version, TSwin version, project name, time, date, number of compilation runs and a random number.

Because the initialization mask is visible only for a few seconds there is a possibility to represent this mask for a longer time period.

1. Hold down an arbitrary key at the operating device to generate an error message.
2. Read the firmware version now.
3. Release the key to complete the initialization procedure of the operating device.

3 Control and Display Elements

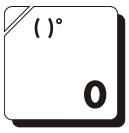
3.1 Keyboard

The keys are positioned under an environmental-proof polyester foil.

Figure 3-1 Front view

1 Company Logo
2 Housing
3 Front Panel
4 Operating Terminal Type
5 Filter Pane for Display Cutout
6 Emergency Stop Button (Option)
7 Status LED "Data Release"
8 Special Key "Data Release"
9 Editing Key "Plus"
10 Editing Key "Minus"
11 Special Key "Enter"
12 Special Key "Delete"
13 Editing Key "Decimal Point"
14 Editing Keys 0 to 9, Alphabet
15 Status LED "Help"
16 Special Key "Help"
17 Control Key "Cursor Home"
18 Control Keys "Cursor Right, Left, Up, Down"
19 Special Key "Print"
20 Status LED "Print"
21 Control Key "Page up"
22 Control Key "Page down"
23 Special Key "Acknowledge"
24 Status LED "Acknowledge"
25 Function Keys F1 to F16
26 Status LEDs of Function Keys

3.1.1 Editing Keys



The key **0 and ()**° is used for changing data in the editor. The (,) and ° characters can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **1 and STU** is used for changing data in the editor. The characters S, T and U can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **2 and VWX** is used for changing data in the editor. The characters V, W and X can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **3 and YZ%** is used for changing data in the editor. The characters Y, Z and % can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **4 and JKL** is used for changing data in the editor. The characters J, K and L can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **5 and MNO** is used for changing data in the editor. The characters M, N and O can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **6 and PQR** is used for changing data in the editor. The characters P, Q and R can be entered when configuring the **Shift** or **ShiftCase** system variables.

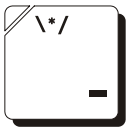
The key **7 and ABC** is used for changing data in the editor. The characters A, B and C can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **8 and DEF** is used for changing data in the editor. The characters D, E and F can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **9 and GHI** is used for changing data in the editor. The characters G, H and I can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **Decimal point and :?!** is used for changing data in the editor. The characters :, ? and ! can be entered when configuring the **Shift** or **ShiftCase** system variables.

The key **Plus and <=>** is used for changing data in the editor. The characters <, = and > can be entered when configuring the **Shift** or **ShiftCase** system variables.



The key **Minus and */** is used for changing data in the editor. The characters \, * and / can be entered when configuring the **Shift** or **ShiftCase** system variables.

3.1.2 Control Keys

The key **Cursor left** can be programmed to directly select adjacent I/O masks. In the editor, it moves the cursor within a variable to the left by one character (character selection).

The key **Cursor right** can be programmed to directly select adjacent nodes and I/O masks. In the editor it moves the cursor one character to the right (character selection).

The key **Cursor up** can be programmed to directly select adjacent nodes and I/O masks. In the editor it moves the cursor up one variable (variable selection).

The key **Cursor down** can be programmed to directly select adjacent I/O masks. In the editor, it moves the cursor downwards to the next variable (variable selection).

The key **Cursor home** can be programmed to directly select higher-level nodes and I/O masks. In the editor it returns the cursor to the first input variable position.

The key **Page up** is used to page through tables, recipes and messages. The functionality corresponds to the system variable TabPgUp. The key allows data content towards the top of the table to be viewed.

The key **Page down** is used to page through tables, recipes and messages. The functionality corresponds to the system variable TabPgDn. The key allows data content towards the bottom of the table to be viewed.

3.1.3 Special Keys

The key **Help** always displays the current help text (online help). The help key LED flashes when a system message is pending. The system message is always displayed in plain-text.

The key **Data Release** is used to switch from the menu into the editor. The integrated LED lights up in the editing mode if the external data release has been set. When the Data Release key is pressed within the editor, the editing mode is exited.

The key **Enter** is used to conclude data entry. When pressed while in the Startup Mask, the key switches into the Setup Mask.

The key **Delete** deletes the character beneath the cursor in the editor. Removes the selected messages from the data memory.

The key **Acknowledge** is used as acknowledge key for the message system. The LED flashes when a acknowledge is required.

The key **Print** can be used as a soft key to activate various print jobs. The LED flashes when a print process is active.

3.2 Function Keys

The function of the function keys is freely assignable (with soft key functions). The function keys can be used either as direct keys for menu control or for triggering a function in the controller.

3.2.1 Function Key Arrangement

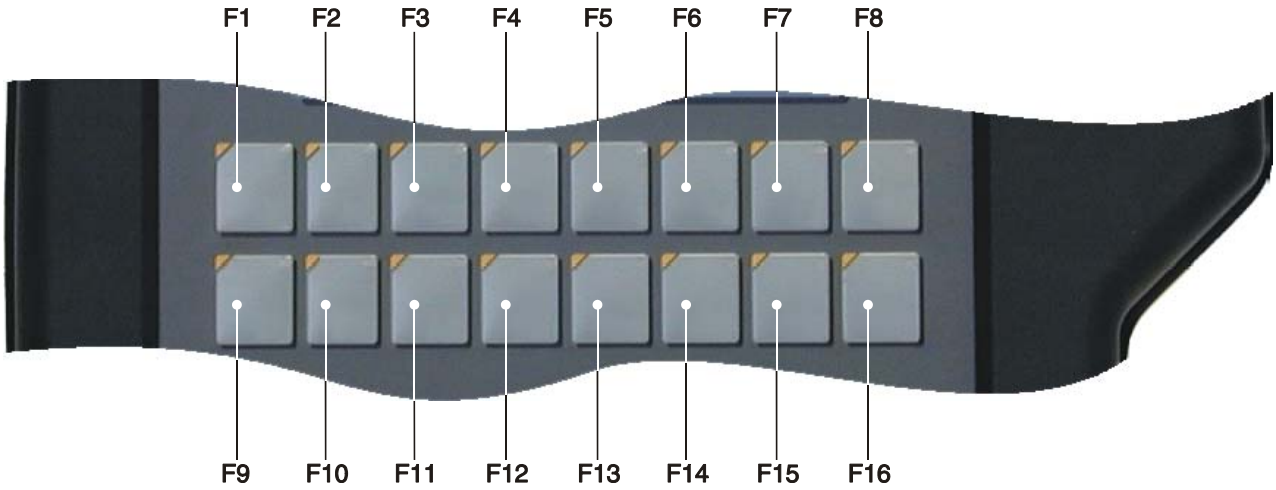


Figure 3-2 Arrangement of the function keys

3.2.2 Slide-in Identification Strips for the Function Keys

When opening and closing the operating device, you must take care not to damage the seal and make sure that it always sits in the slot provided.

Electrostatic discharge can damage electronic components! **Observe the ESD protective measures!**

To change the slide-in identification strips, proceed as follows:

1. Remove the screws on the rear of the housing and lift off the housing.
2. Now change the identification strips (see figure).
3. After changing the identification strips place the housing rear panel back onto the device.
4. Carefully tighten the screws of the rear panel again.

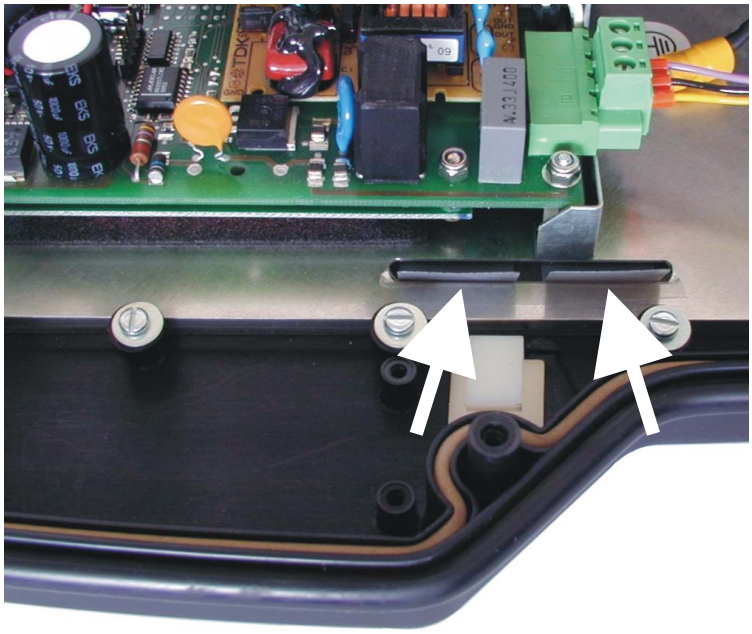


Figure 3-3 Position of the slide-in identification strips

The identifications strips can be replaced when the operating device is built-in or removed. Inserting the strip from the rear side of the front plate does not influence the specified seal of the operator terminal. A set of identification strips is supplied with the operator terminal.

For the labeling use:

Single pieces, prototypes	Label with a water-resistant pen
Small series	Copying foil (thickness <= 70 µm) with laser print
Large series	Customer-specific labeled identification strips

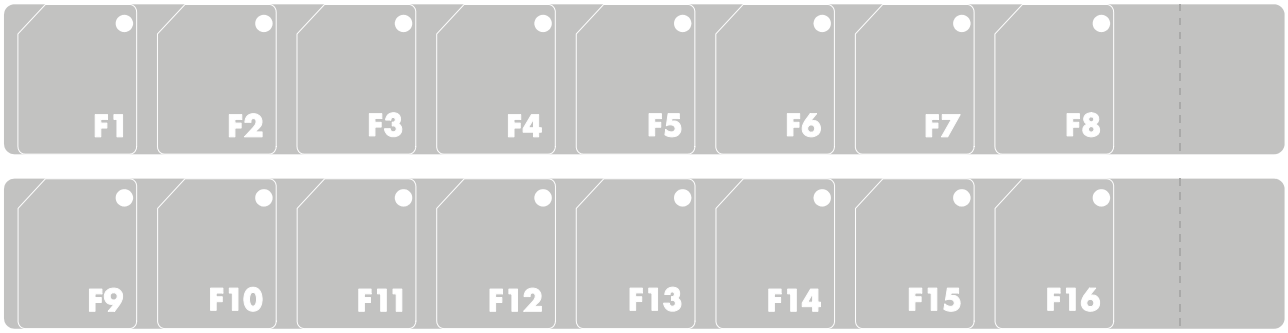


Figure 3-4 Identification strip, labeled

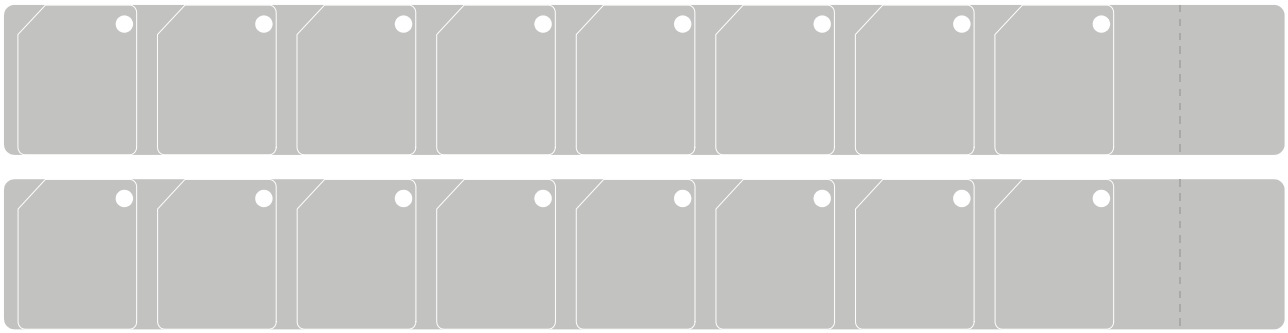


Figure 3-5 Identification strip, unlabeled

3.3 Stop Pushbutton / Emergency Stop Button

The device can be fitted with an optional STOP pushbutton or an emergency stop button.

The STOP pushbutton on the operating device ensures that the system to be monitored is shut down safely in accordance with EN 60204-1:1997, Paragraph 9.2.5.3. The stop function can be a Category 0, 1 or 2 stop according to EN 60204-1:1997, Paragraph 9.2.2 and must be defined according to the risk assessment.

Therefore, the stop function of the operating device can be used for a safe machine stop as well as for looping into the emergency stop circuit of the system to be monitored.

The signals of the STOP pushbutton use different circuits in the two versions of the linkbox. In the case of the linkbox with an emergency stop function, the signals control the stop circuit or emergency stop circuit of the system to be monitored. If no hand-held operating device is connected, the stop circuit or emergency stop circuit, respectively, is closed. In the linkbox without an emergency stop function, on the other hand, the signals of the stop circuit or emergency stop circuit are sent via the STOP pushbutton. If no hand-held operating device is connected, the stop circuit or emergency stop circuit, respectively, of the system to be monitored is open.

The term "stop looping" has the following meaning: The stop circuit or emergency stop circuit, respectively, of the system to be monitored is looped through the linkbox and not interrupted, irrespective of whether the hand-held operating device is connected to the linkbox (and the STOP pushbutton has not been operated) or not. This functionality is only available with the linkbox with an emergency stop function.

Warning!
If using a hand-held operating device with an emergency stop button, you must ensure that the connecting cable is securely installed.
A hand-held operating device that is not connected to the machine must be stored out of sight of the user!
Bear in mind that the nearest emergency stop will be activated in the event of danger. If it does not work because it is not connected, this could have fatal consequences!

Warning!
If the hand-held operating device is equipped with a STOP pushbutton but it is not connected to the linkbox, a stop can not be triggered using the hand-held operating device – the STOP pushbutton of the hand-held operating device is ineffective!
Install stationary emergency stop buttons that are available at all times on the system to be monitored.

Warning!
If the stop circuit has been implemented as a Category 0 or 1 stop, the stop function must be effective regardless of the operating mode. A Category 0 stop must have priority. The releasing of the STOP pushbutton must NOT lead to hazardous conditions (also see EN 60204-1:1997 Chapter 9.2.5.3).
The stop function is not a substitute for safety devices.

The following standards must be applied for the risk analysis to be carried out:

- EN 292, General principles for machine design
- EN 1050, Risk assessment of machines
- EN 954-1, Safety-related parts of control systems

These considerations are combined to form a safety category (B, 1, 2, 3, 4) in accordance with EN 954-1, which stipulates the characteristics of the safety-related parts for the system to be monitored.

3.4 Consent Switch

The device can be fitted with an optional handle set featuring an integrated 3-step consent switch. Operating sequences can only be performed if the 3-step switch is set to its middle position. The stop signal is issued when the switch is set to its upper and lower position. After a stop in the lowest position, the release command can only be issued if the switch is fully released and pushed to the middle position again.

Each machine can run in two operating modes, normal mode and special mode. In normal mode (automatic), the machine performs its normal operational tasks. In this mode, safety is provided by closed, isolating protective equipment and/or using active non-isolating protective equipment that blocks access.

The special operating modes of a machine are designed to maintain the normal mode. In this case, safety must be ensured in a different manner than is provided during normal mode because hazardous areas of the machine must be accessed and specific movements must be possible.

In this case, it must be possible to operate the machine at a reduced speed in accordance with the risk assessment, whereby movement is only possible if the consent equipment is actuated simultaneously. The operator must possess the necessary qualifications and training and be familiar with the details of the intended use in accordance with the instruction manual.

The safety-related parts of the controller used to reduce the speed and for the consent equipment must be constructed so that they comply with the EN 954-1 safety category determined on the basis of the risk analysis.

The use of a 2-circuit design for the consent equipment enables compliance with safety category 3 according to EN 954-1:1996. The draft C-standard covering machine tools and processing machinery stipulates the following:
Consent equipment may consist of either a 2-position command unit combined with a stop module or of a 3-position command unit. The use of a 3-position command unit is preferable.

EN 60204 describes the mode of operation of the consent equipment. Based on information gathered from accident research and on the technical solutions currently available, the 3-step consent switch represents state-of-the-art technology. Positions 1 and 3 of the consent switch are "OFF" functions. Only the middle position activates consent. EN 60204-1:1997 is identical to IEC 60204-1, as a result of which the 3-step consent switch is internationally recognized.

The stop category of the consent equipment must be selected on the basis of a risk assessment and must correspond to a Category 0 or Category 1 stop.

Warning!
The consent switch is only suitable for use as a protection function if the person operating the consent switch is able to recognize hazards to personnel in good time and can then immediately initiate hazard prevention measures!
Slower movement speed may also be necessary as an additional measure. The permissible speed must be determined on the basis of a risk assessment.

Warning!
No commands related to hazardous conditions may be initiated by the consent switch alone. A second, conscious start command is necessary (button on hand-held operating device). Only the person operating the consent switch is permitted to be present in the hazardous area.

The following standards must be applied for the risk analysis to be carried out:

- EN 292, General principles for machine design
- EN 1050, Risk assessment of machines

- EN 954-1, Safety-related parts of control systems

These considerations are combined to form a safety category (B, 1, 2, 3, 4) in accordance with EN 954-1, which stipulates the characteristics of the safety-related parts for the system to be monitored.

3.5 User Mode Switch

When opening and closing the operating device, you must take care not to damage the seal and make sure that it always sits in the slot provided.

Electrostatic discharge can damage electronic components! **Observe the ESD protective measures!**

The user mode switch is positioned at the bottom right in the top shell of the operating device. To operate the user mode switch proceed as follows:

1. Disconnect the operating device from the supply voltage.
2. Remove the screws on the rear of the housing and lift off the housing.
3. Set the desired operating mode (see table).
4. After setting the operating mode, place the housing rear panel back onto the device.
5. Carefully screw the screws tightly into the rear panel of the housing again.
6. Connect the operating device with the supply voltage.

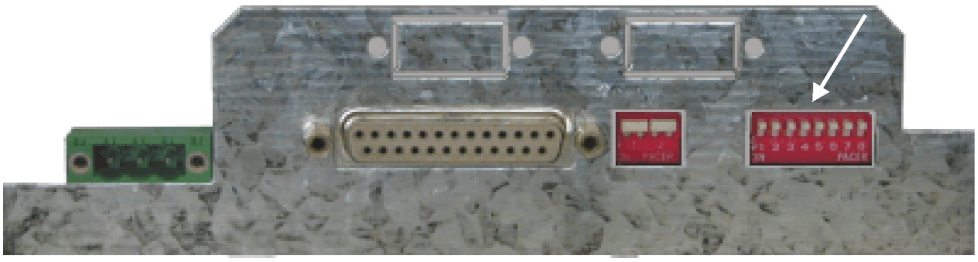


Figure 3-6 Position of user mode switch

The switch positions for ON or OFF are printed onto the termination switch.

Table 3-1 User Mode Switch

S1	S2	S3	S4	S5	S6	S7	S8	Operating Mode
I	X	–	–	X	X	X	X	Standard mode with PLC (default upon delivery)
I	X	I	–	X	X	X	X	Standard mode without PLC
–	I	–	–	X	X	X	X	Transparent mode with start and stop code of keys
–	–	–	I	X	X	X	X	Transparent mode without stop code of keys
I	–	–	I	X	X	X	X	Activate download (deletes application memory) and default contrast / default brightness setting
I	–	I	I	X	X	X	X	Activate upload

Legend for table:

I = Switch ON

- = Switch OFF

X = Any switch position

3.6 Display

Danger - Toxic!
If the display is damaged, avoid touching, swallowing or breathing in the liquids or gases which may leak out!

Danger - Corrosive!
If the display is damaged, avoid touching, swallowing or breathing in the liquids or gases which may leak out!

The operating device is equipped with a LC-Display.

3.6.1 Contrast Setting

To define the contrast setting, use the programming software to set up the system variable **LcdContrast** in any mask.

To do so, follow the instructions listed in the programming software's help topic "How do I specify the contrast setting for the operating device".

In the programming software, enter the following values as lower and upper limits for the representation type.

Table 3-2 Values for the representation type

System variable	Lower limit	Upper limit	Default setting
LcdContrast	- 25	+ 70	+ 25

f you do not configure the system variable **LcdContrast**, the default setting is used when the device is initialized.

If you did set-up the system variable, you can set the contrast as follows. Open the mask where you set up the system variable and:

1. Press the data release key if the data release is not automatically active.
2. Enter a new value for the contrast. To do so, use the keys plus and minus.
3. Confirm with Enter.
4. Finally press the data release key.

The new contrast setting becomes effective immediately after the Enter key is pressed. If necessary, repeat the steps two and three until you are satisfied with the contrast.

3.6.2 Default Contrast Setting

If the contrast setting is such that it is no longer possible to read the masks, you can use the user mode switch to reset the contrast to the default value.

For the table with the switch positions of the user mode switch, see chapter "User Mode Switch".

The switch position for the default contrast is identical with the „Activate download via hardware“. The contrast is reset before a corresponding message is displayed. The warning will be displayed in a legible manner.

To restore the default contrast / brightness:

1. Switch the device off.
2. Set the switches S1 and S4 of the user mode switch to ON.
3. Switch the device on again.
4. When the warning appears, switch the device off again.
5. Set switch S4 to OFF.
6. Then switch the device on again.

The application will not be lost.

3.6.3 Character Attributes

The following character attributes can be displayed on the device:

– Normal
– Flashing
– Underlined
– Inverse

3.6.4 Fonts

You are able to use the Windows character sets. Further you can use the font "Normal" and the font "Zoom" or create and use your own character sets.

4 Interfaces of the Device

Depending on the device variant, several interfaces are available to you:

Table 4-1 Device Variants

Order number	Available Interfaces						Connector			Termination	
	RS232 (Download/Upload)	RS485	RS232 (Communication)	PROFIBUS-DP	MPI	INTERBUS	Open Cable End	16 Pin Connector	19 Pin Connector	Participants	Last Device
HT20/01xxx/xxx/00xxx	X	X	-	-	-	-	X	-	-	-	-
HT20/01xxx/xxx/03xxx	X	X	-	-	-	-	-	X	-	-	-
HT20/02xxx/xxx/00xxx	X	-	X	-	-	-	X	-	-	-	-
HT20/02xxx/xxx/03xxx	X	-	X	-	-	-	-	X	-	-	-
HT20/08xxx/xxx/00xxx	X	-	-	X	-	-	X	-	-	X	-
HT20/08xxx/xxx/03xxx	X	-	-	X	-	-	-	X	-	X	-
HT20/52xxx/xxx/00xxx	X	-	-	X	-	-	X	-	-	-	X
HT20/52xxx/xxx/05xxx	X	-	-	X	-	-	-	-	X	-	X
HT20/16xxx/xxx/00xxx	X	-	-	-	X	-	X	-	-	X	-
HT20/16xxx/xxx/03xxx	X	-	-	-	X	-	-	X	-	X	-
HT20/16xxx/xxx/05xxx	X	-	-	-	X	-	-	-	X	X	-
HT20/53xxx/xxx/00xxx	X	-	-	-	X	-	X	-	-	-	X
HT20/53xxx/xxx/05xxx	X	-	-	-	X	-	-	-	X	-	X
HT20/18xxx/xxx/00xxx	X	-	-	-	-	X	X	-	-	-	-
HT20/18xxx/xxx/03xxx	X	-	-	-	-	X	-	X	-	-	-

The standard operating device is supplied with an open cable end.Optionally, the operating device can be equipped with an assembled 16 or 19 pin connector.

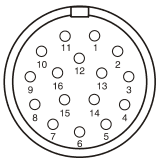


Figure 4-1 Pin diagram for 16 pin connector

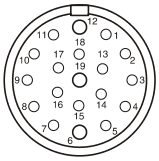


Figure 4-2 Pin diagram for 19 pin connector

The connecting cable is constructed of five components.

1. 3 x 0.5 mm² (not shielded) for supply voltage
2. 2 x 0.25 mm² (shielded) for communication
3. 3 x 0.25 mm² (shielded) for communication
4. 5 x 0.25 mm² (not shielded) for emergency stop button and consent switch
5. 2 x 0.5 mm² single wires for emergency stop button and 5 x 0.25 mm² single wires for consent switch or command devices

4.1 RS232 (Download / Upload)

The interface is only designed to be used for downloads, uploads, a scanner or a logging printer because the interface is not electrically isolated.

To carry out a download or an upload, proceed as follows:

1. Carefully unscrew and remove the protective cap (see figure) of the download/upload interface.
2. Plug the cable onto the interface of the operating device.
3. Connect the other end of the cable with the serial interface of the PC.
4. Now carry out the download or upload.
5. After the download/upload is complete, remove the cable from the interfaces again.
6. Carefully tighten the protective cap for the download/upload interface again.

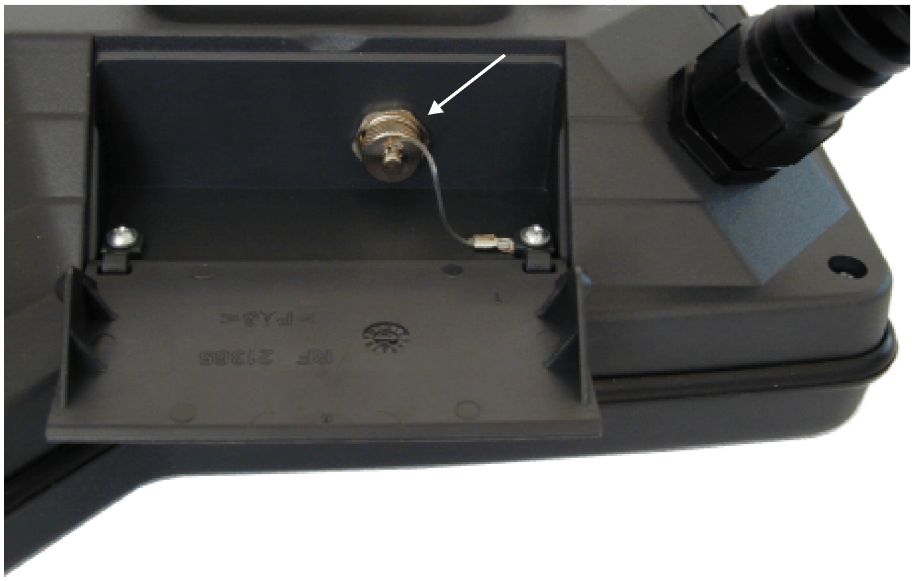


Figure 4-3 Position of download/upload interface

4.1.1 Pin Assignment

Connector in the operating device: 5 pin female connector - Binder series 702.

Table 4-2 Pin assignment of RS232 interface

Pin	Designation	Function
1	TD	Transmitted Data
2	RD	Received Data
3	CTS	Clear to Send
4	RTS	Request to Send
5	GND	Ground

You can obtain an assembled cable directly from Sütron electronic.

4.2 RS485

The interface is suitable for point-to-point and for multi-point connections.

The wires belonging together are marked with „A“ and „B“. Some descriptions refer to the pins with „+“ and „-“ , where A = + and B = -.

Signal Logic 1 $U_A - U_B <= -0.3$ V i.e. ($U_A < U_B$)

Signal Logic 0 $U_A - U_B >= +0.3$ V i.e. ($U_A > U_B$)

4.2.1 Pin/Cable Assignment

Pin/cable assignment for open cable end or 16 pin connector.

Table 4-3 Pin/cable assignment - RS485

Pin	Wire	ø mm²	Design.	Function
8	BK	3 x 0.5	0 V	Supply Voltage 0 VDC
9	VT		+ 24 V	Supply Voltage 24 VDC
10	YE		⏚	Low-Noise Ground
15	RD	2 x 0.25	T(B)	Transmitted Data (-)
16	GN		T(A)	Transmitted Data (+)
7	GR	3 x 0.25	SGND	Signal Ground
13	WH		RD(A)	Received Data (+)
14	BN		RD(B)	Received Data (-)
5	WHYE	5 x 0.25	O	Emergency Stop Break Contact Channel 1
6	BNGN		O	Emergency Stop Break Contact Channel 1
11	PK		S	Consent Switch Channel 1
1	RDBU		S	Consent Switch Channel 1
2	WHGN		S	Consent Switch Channel 2
12	OR	0.25	S	Consent Switch Channel 2
3	BU	0.5	O	Emergency Stop Break Contact Channel 2
4	BN	0.5	O	Emergency Stop Break Contact Channel 2

The items in the lower table section are only available as options.

For operating devices with open cable ends, make sure to connect the shield with the protective ground.

4.2.2 Termination

For point-to-point connections, always activate the termination. For multi-point connections, only activate the termination at the cable end.

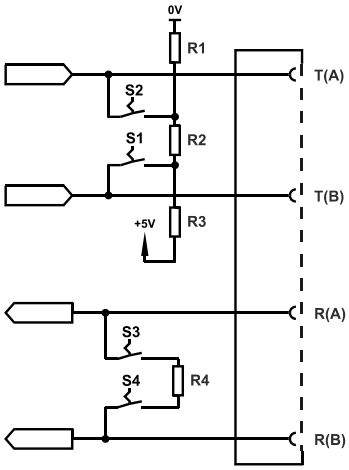


Figure 4-4 Block diagram termination RS485

Table 4-4 Resistance values termination RS485

Designation	Value
R1, R3	510 Ohm
R2	150 Ohm
R4	120 Ohm

The switch positions for ON or OFF are printed onto the termination switch. Only the specified switch positions are allowed.

Table 4-5 Termination switch

S1	S2	S3	S4	Function
Transmitter		Receiver		
I	I	I	I	Termination is ON
–	–	–	–	Termination is OFF

Legend for table:

I = Switch ON

- = Switch OFF

When opening and closing the operating device, you must take care not to damage the seal and make sure that it always sits in the slot provided.

Electrostatic discharge can damage electronic components! **Observe the ESD protective measures!**

The termination switch (see figure) is located in the top shell of the operating device. To operate the termination switch, proceed as follows:

1. Remove the screws on the rear of the housing and lift off the housing.
2. Set the termination as desired.
3. After setting the termination, place the housing rear panel back onto the device.
4. Carefully tighten the screws of the rear panel again.

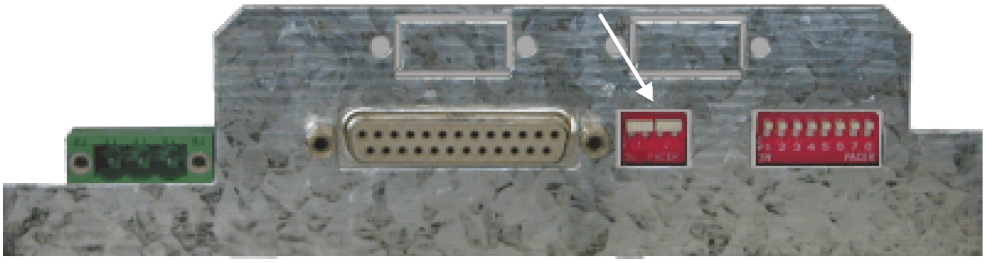


Figure 4-5 Position of termination switches RS485

4.3 RS232 (Communication)

The interface is suitable to establish a point-to-point connection.

4.3.1 Pin/Cable Assignment

Pin/cable assignment for open cable end or 16 pin connector.

Table 4-6 Pin/cable assignment - RS232

Pin	Wire	ø mm²	Design.	Function
8	BK	3 x 0.5	0 V	Supply Voltage 0 VDC
9	VT		+ 24 V	Supply Voltage 24 VDC
10	YE		⏚	Low-Noise Ground
15	RD	2 x 0.25	RD	Received Data
16	GN		CTS	Clear to Send
7	GR	3 x 0.25	SGND	Signal Ground
13	WH		TD	Transmitted Data
14	BN		RTS	Request to Send
5	WHYE	5 x 0.25	O	Emergency Stop Break Contact Channel 1
6	BNGN		O	Emergency Stop Break Contact Channel 1
11	PK		S	Consent Switch Channel 1
1	RDBU		S	Consent Switch Channel 1
2	WHGN		S	Consent Switch Channel 2
12	OR	0.25	S	Consent Switch Channel 2
3	BU	0.5	O	Emergency Stop Break Contact Channel 2
4	BN	0.5	O	Emergency Stop Break Contact Channel 2

The items in the lower table section are only available as options.

For operating devices with open cable ends, make sure to connect the shield with the protective ground.

4.3.2 Termination

When using the RS232 interface, switch OFF the termination for the RS485.

4.4 INTERBUS

The device can be integrated into the INTERBUS using the interfaces available for INTERBUS connections.

4.4.1 Pin/Cable Assignment

Pin/cable assignment for open cable end or 16 pin connector.

Table 4-7 Pin/cable assignment - INTERBUS

Pin	Wire	ø mm²	Design.	Function
8	BK	3 x 0.5	0 V	Supply Voltage 0 VDC
9	VT		+ 24 V	Supply Voltage 24 VDC
10	YE		⏚	Low-Noise Ground
15	RD	2 x 0.25	$\overline{DO}$	Data Output, Inverted
16	GN		DO	Data Output
7	GR	3 x 0.25	GND	Ground
13	WH		DI	Data Input
14	BN		$\overline{DI}$	Data Input, Inverted
5	WHYE	5 x 0.25	O	Emergency Stop Break Contact Channel 1
6	BNGN		O	Emergency Stop Break Contact Channel 1
11	PK		S	Consent Switch Channel 1
1	RDBU		S	Consent Switch Channel 1
2	WHGN		S	Consent Switch Channel 2
12	OR	0.25	S	Consent Switch Channel 2
3	BU	0.5	O	Emergency Stop Break Contact Channel 2
4	BN	0.5	O	Emergency Stop Break Contact Channel 2

The items in the lower table section are only available as options.

For operating devices with open cable ends, make sure to connect the shield with the protective ground.

4.4.2 Cable

A shielded twisted-pair cable (cable type LiYCY-TP) must be used. The maximum cable length depends on its use within the INTERBUS topology.

4.4.3 Diagnostics

When opening and closing the operating device, you must take care not to damage the seal and make sure that it always sits in the slot provided.

Electrostatic discharge can damage electronic components! **Observe the ESD protective measures!**

Diagnostics LED are located in the operating device. To be able to check the statuses of the bus system, proceed as follows:

1. Remove the screws on the rear of the housing and lift off the housing.
2. Check the status of the diagnostics LEDs.
3. After the diagnostics is complete, place the housing rear panel back onto the device.
4. Carefully tighten the screws of the rear panel again.

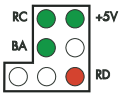


Figure 4-6 Position of INTERBUS diagnostics LEDs

The diagnostics LEDs on the operating device have the following functions:

Table 4-8 Functions of INTERBUS diagnostics LEDs

Designation	Color	State	Function
RC	Green	ON	Field Bus Check
+5 V	Green	ON	Supply Voltage OK
		OFF	No Supply Voltage Present
BA	Green	ON	Bus Active
		OFF	Bus Not Active
RD	Red	ON	Remote Bus Switched Off

4.5 MPI

The device can be integrated into a Siemens MPI bus structure using the interface available for Siemens MPI connections.

4.5.1 Pin/Cable Assignment

Pin/cable assignment for open cable end or 16 pin connector.

Table 4-9 Pin/cable assignment MPI

Pin	Wire	ø mm²	Design.	Function
8	BK	3 x 0.5	0 V	Supply Voltage 0 VDC
9	VT		+ 24 V	Supply Voltage 24 VDC
10	YE		⏚	Low-Noise Ground
15	RD	2 x 0.25	RxD/TxD-P (IN)	Received Data / Transmitted Data Plus
16	GN		RxD/TxD-N (IN)	Received Data / Transmitted Data Minus
7	GR	3 x 0.25	DGND	Data Transfer Potential
13	WH		RxD/TxD-N (OUT)	Received Data / Transmitted Data Minus
14	BN		RxD/TxD-P (OUT)	Received Data / Transmitted Data Plus
5	WHYE	5 x 0.25	O	Emergency Stop Break Contact Channel 1
6	BNGN		O	Emergency Stop Break Contact Channel 1
11	PK		S	Consent Switch Channel 1
1	RDBU		S	Consent Switch Channel 1
2	WHGN		S	Consent Switch Channel 2
12	OR	0.25	S	Consent Switch Channel 2
3	BU	0.5	O	Emergency Stop Break Contact Channel 2
4	BN	0.5	O	Emergency Stop Break Contact Channel 2

The items in the lower table section are only available as options.

For operating devices with open cable ends, make sure to connect the shield with the protective ground.

Pin/cable assignment for open cable end or 19 pin connector. The pin assignment is for connection to the Linkbox HL01 DP/MPI. A Linkbox HL01 DP/MPI can be obtained directly from Sütron electronic.

Table 4-10 Pin/cable assignment MPI

Pin	Wire	ø mm²	Design.	Function
1	BK	3 x 0.5	0 V HT	Supply Voltage 0 VDC
2	VT		24 V HT	Supply Voltage 24 VDC
12	YE		⏚	Low-Noise Ground
13	GN	2 x 0.25	RxD/TxD-N	Received Data / Transmitted Data Minus
14	RD		RxD/TxD-P	Received Data / Transmitted Data Plus
11	WH	3 x 0.25	CNTR-P	Repeater Control Signal Plus
18	GR		DGND	Data Transfer Potential
-	BN		nc	Not Connected
3	-	-	Jumper in Connector to Pin 4	
4	-	-	Jumper in Connector to Pin 3	
5	-	-	Jumper in Connector to Pin 15	
15	-	-	Jumper in Connector to Pin 5	
-	YEBN	0.25	nc	Not Connected
-	WHPK	0.25	nc	Not Connected
-	WHGR	0.25	nc	Not Connected
-	GRBN	0.25	nc	Not Connected
9	WHYE	5 x 0.25	O	Emergency Stop Break Contact Channel 1
16	BNGN		O	Emergency Stop Break Contact Channel 1
17	PK		S	Consent Switch Channel 1
6	RDBU		S	Consent Switch Channel 1
19	WHGN		S	Consent Switch Channel 2
10	OR	0.25	S	Consent Switch Channel 2
7	BU	0.5	O	Emergency Stop Break Contact Channel 2
8	BN	0.5	O	Emergency Stop Break Contact Channel 2

The items in the lower table section are only available as options.

For operating devices with open cable ends, make sure to connect the shield with the protective ground.

4.5.2 Cable

Any cable that conforms with the following parameters can be used:

Table 4-11 Cable characteristics MPI

Parameters	Value
Loop Resistance	110 Ohm/km
Capacitance	30 nF/km
Surge Impedance	150 Ohm

The maximum length of one segment is 50 m which cannot be exceeded. This 50 m applies from the first node to the last node in the segment.

For further information on the installation, please refer to the Siemens manual "SIMATIC S7-400 and M7-400 Programmable Controllers Hardware and Installation, 6ES7498-8AA03-8BA0".

4.5.3 Termination

The terminations of the operating device are factory-set.

Use the order number of the operating device to check the status of the termination. For this purpose, refer to the "Device Variants" table.

4.5.4 Diagnostics

When opening and closing the operating device, you must take care not to damage the seal and make sure that it always sits in the slot provided.

Electrostatic discharge can damage electronic components! **Observe the ESD protective measures!**

A diagnostics LED is located in the operating device. To be able to check the status of the bus system, proceed as follows:

1. Remove the screws on the rear of the housing and lift off the housing.
2. Check the status of the diagnostics LED.
3. After the diagnostics is complete, place the housing rear panel back onto the device.
4. Carefully tighten the screws of the rear panel again.

The diagnostics LED on the operating device has the following functions:

Table 4-12 Function of the MPI diagnostics LED

Color	State	Function
Green	Flashing	Operating Device has the Token

4.6 PROFIBUS-DP

The interface for PROFIBUS-DP connections is available to integrate the device into a PROFIBUS-DP structure.

4.6.1 Pin/Cable Assignment

Pin/cable assignment for open cable end or 16 pin connector.

Table 4-13 Pin/cable assignment - PROFIBUS-DP

Pin	Wire	ø mm²	Design.	Function
8	BK	3 x 0.5	0 V	Supply Voltage 0 VDC
9	VT		+ 24 V	Supply Voltage 24 VDC
10	YE		⏚	Low-Noise Ground
15	RD	2 x 0.25	RxD/TxD-P (IN)	Received Data / Transmitted Data Plus
16	GN		RxD/TxD-N (IN)	Received Data / Transmitted Data Minus
7	GR	3 x 0.25	DGND	Data Transfer Potential
13	WH		RxD/TxD-N (OUT)	Received Data / Transmitted Data Minus
14	BN		RxD/TxD-P (OUT)	Received Data / Transmitted Data Plus
5	WHYE	5 x 0.25	O	Emergency Stop Break Contact Channel 1
6	BNGN		O	Emergency Stop Break Contact Channel 1
11	PK		S	Consent Switch Channel 1
1	RDBU		S	Consent Switch Channel 1
2	WHGN		S	Consent Switch Channel 2
12	OR	0.25	S	Consent Switch Channel 2
3	BU	0.5	O	Emergency Stop Break Contact Channel 2
4	BN	0.5	O	Emergency Stop Break Contact Channel 2

The items in the lower table section are only available as options.

For operating devices with open cable ends, make sure to connect the shield with the protective ground.

Pin/cable assignment for open cable end or 19 pin connector. The pin assignment is for connection to the Linkbox HL01 DP/MPI. A Linkbox HL01 DP/MPI can be obtained directly from Sütron electronic.

Table 4-14 Pin/cable assignment - PROFIBUS-DP

Pin	Wire	ø mm²	Design.	Function
1	BK	3 x 0.5	0 V HT	Supply Voltage 0 VDC
2	VT		24 V HT	Supply Voltage 24 VDC
12	YE		⏚	Low-Noise Ground
13	GN	2 x 0.25	RxD/TxD-N	Received Data / Transmitted Data Minus
14	RD		RxD/TxD-P	Received Data / Transmitted Data Plus
11	WH	3 x 0.25	CNTR-P	Repeater Control Signal Plus
18	GR		DGND	Data Transfer Potential
-	BN		nc	Not Connected
3	-	-	Jumper in Connector to Pin 4	
4	-	-	Jumper in Connector to Pin 3	
5	-	-	Jumper in Connector to Pin 15	
15	-	-	Jumper in Connector to Pin 5	
-	YEBN	0.25	nc	Not Connected
-	WHPK	0.25	nc	Not Connected
-	WHGR	0.25	nc	Not Connected
-	GRBN	0.25	nc	Not Connected
9	WHYE	5 x 0.25	O	Emergency Stop Break Contact Channel 1
16	BNGN		O	Emergency Stop Break Contact Channel 1
17	PK		S	Consent Switch Channel 1
6	RDBU		S	Consent Switch Channel 1
19	WHGN		S	Consent Switch Channel 2
10	OR	0.25	S	Consent Switch Channel 2
7	BU	0.5	O	Emergency Stop Break Contact Channel 2
8	BN	0.5	O	Emergency Stop Break Contact Channel 2

The items in the lower table section are only available as options.

For operating devices with open cable ends, make sure to connect the shield with the protective ground.

4.6.2 Cable

Any PROFIBUS-DP-approved cables specified in the EN 50170 as cable type A can be used.

Table 4-15 Cable characteristics PROFIBUS

Parameters	Value
Impedance	136 to 165 Ohm
Capacitance	< 30 pf/m
Loop Resistance	110 Ohm/km
Wire Gauge	0.64 mm

The maximum cable length depends on the baud rate (DIN EN 19245 Part 3).

Table 4-16 Baud rate PROFIBUS-DP

Baud Rate	Cable Length
187.5 kBit/s	1000 m
500 kBit/s	400 m
1500 kBit/s	200 m
3000 to 12000 kBit/s	100 m

4.6.3 Termination

The terminations of the operating device are factory-set.

Use the order number of the operating device to check the status of the termination. For this purpose, refer to the "Device Variants" table.

4.6.4 Diagnostics

When opening and closing the operating device, you must take care not to damage the seal and make sure that it always sits in the slot provided.

Electrostatic discharge can damage electronic components! **Observe the ESD protective measures!**

A diagnostics LED is located in the operating device. To be able to check the status of the bus system, proceed as follows:

1. Remove the screws on the rear of the housing and lift off the housing.
2. Check the status of the diagnostics LED.
3. After the diagnostics is complete, place the housing rear panel back onto the device.
4. Carefully tighten the screws of the rear panel again.

The diagnostics LED on the operating device has the following functions:

Table 4-17 Function of the PROFIBUS-DP diagnostics LED

Color	State	Function
Green	ON	Communication Active

5 Maintenance and Servicing

5.1 Maintenance Interval

The following maintenance intervals are recommended for this operating device:

Table 5-1

Maintenance work	Interval
Changing the Battery	4 Years

5.2 Front Panel

Only use a damp cloth to remove any dirt from the front panel.

5.3 Fuse

The semiconductor fuse cannot be replaced!

A semiconductor fuse is used to protect the device. Once the fuse has been tripped, the device must be disconnected from the supply voltage to allow the semiconductor fuse to regenerate. At an ambient temperature of 20 °C (68 °F), the regeneration takes approximately 20 seconds. The higher the ambient temperature, the longer the regeneration takes.

5.4 Battery

The built-in battery preserves the data in the CMOS-RAM and supplies the real-time clock. The minimum battery life is 5 years, even under unfavorable operating conditions. When the battery runs down, the message „Change battery“ is generated automatically.

We recommend you change the battery approximately every 4 years as part of the regular maintenance work. A prepared battery including connector can be obtained directly from Sütron electronic.

If the „Change battery“ message is detected too late, e.g. the real-time clock stopped or shows the wrong date, data in the CMOS-RAM may have already been lost. For this reason, after changing a battery, always check data such as passwords that can be modified, parameters in the system variables, recipe data sets and entries in the message system.

5.4.1 Changing the Battery

Batteries must only be changed by authorized and trained experts!

For changing the battery you may only use replacement batteries of Sütron electronic.

Electrostatic discharge can damage electronic components! **Observe the ESD protective measures!**

Do not throw lithium batteries into fire, do not heat to 100 °C or higher and do not recharge. **Danger - Explosive!**

Do not open lithium batteries. **Danger - Toxic!**

When opening and closing the operating device, you must take care not to damage the seal and make sure that it always sits in the slot provided.

To ensure that the data in the CMOS-RAM and the time are preserved, it is possible to change the battery under operating voltage. Please note the safety notes!

1. Remove the screws on the rear of the housing and lift off the housing.
2. Remove the cable fastener which secures the battery.
3. Disconnect the battery connector and remove the dead battery.
4. Plug in the cable for the new battery.
5. Use a cable fastener to attach the new battery to the plastic support.
6. Place the rear panel back onto the device.
7. Carefully screw the screws tightly into the rear panel.

5.4.2 Battery Disposal

To prevent short circuitry in the collection boxes, insulate the poles of each battery with insulation tape or put each single battery into a plastic bag.

You must always return old batteries to a dealer or to a returns depot set up for this purpose by the public waste disposal body or a licensed battery dealer for recycling. Only dispose of dead batteries in public or commercial collection boxes. The battery is drained when the message „Change battery“ appears on the display of the device.

6 Technical Data

Keyboard	
Type	Membrane Keyboard
Number of Keys	42
Actuator Travel	0.6 mm (0.023")
Actuating Force	3 N
Switching Cycles	Approx. 3 Millions Under the Following Conditions: Pressing Element: Test Plunger (DIN 42115) Pressing Force: 10 N Pressing Frequency: 1 Hz
Lifetime (Min.)	2 Million Switching Cycles
Display Elements	20 Status LEDs

Display	
Type	LCD Module with CCFT Lighting
Resolution	240 x 128 Pixels
Reading Angle	90°
Default Contrast / Default Brightness Setting	By User Mode Switch
LCD Lifetime	100.000 h
Half-Life Backlighting	50.000 h
Lines (Font: Normal)	16
Characters/Line (Font: Normal)	40
Display Area	69 mm x 123 mm (2.717" x 4.843") - (H x W)

Electrical Data	
Supply Voltage	24 V DC (SELV according to DIN EN 61131)
Residual Ripple	10% Maximum
Minimum Voltage	19.2 V
Maximum Voltage	30.2 V
Current Consumption (Field Bus Device)	0.3 A
Connected Load	7.2 W
Fuse	Semiconductor Fuse, Self-Resetting
Protection Against Polarity Reversal	Built-in

Emergency Stop Switch		
According to EN 418		
Type	Rafi Lumotast 25 (1.15154.016)	Rafi Rafix 16 (1.30074.122)
Switching Element	2 Break Contacts	2 Break Contacts
Lifetime	150 000 Switching Cycles	Switching Element (DC): 1 Million Switching Cycles Confirmation Button: 10 000 Switching Cycles

Stop Pushbutton	
According to EN 60204-1	
Type	Rafi Rafix 16 (9.30074.006)
Switching Element	2 Break Contacts
Lifetime	Switching Element: 500 000 Switching Cycles Confirmation Button: 30 000 Switching Cycles

Consent Switch - Jokab	
According to EN 60204-1	
Type	Jokab Safety JSHD4H2
Switching Element	3-Step Switch (2 Channels)
Mechanical Lifetime	>1 Million Switching Cycles (Upper Position to Middle Position)>100 000 Switching Cycles (Middle Position to Lower Position)

Consent Switch - Euchner	
Type	ZSE2-4C1943
Switching Element	3-Step Switch (2 Channels)
Mechanical Lifetime	1 Million Switching Cycles

Interfaces	
Variable Baud Rates and Data Formats	
RS485	In Accordance With DIN 66259-4 Transmission Length: 0 - 1200 m (up to 3937 feet), Twisted Pair Wire, Shielded Galvanically Isolated
RS232 (Communication)	According To DIN 66259 T1, CCITT V.28 Transmission Length: 0 - 15 m (0 - 49.212 feet), Layer-Stranded Conductors, Shielded Galvanically Isolated
RS232 (Download / Upload)	According To DIN 66259 T1, CCITT V.28 Transmission Length: 0 - 15 m (0 - 49.212 feet), layer-stranded conductors, shielded galvanically not isolated
INTERBUS	Galvanically Isolated
MPI	Galvanically Isolated
PROFIBUS-DP	Galvanically Isolated

Central Unit	
Central Unit	Z84
Clock Frequency	10 MHz
Other Characteristics	Watchdog Timer, Real-Time Clock, Temperature Compensation of the Display, Battery Monitoring

Memory	
Application Memory	256 / 768 KByte Flash
RAM	128 Kbyte Static CMOS-RAM, Battery-Backed

Connection System
Angle Connector (Hummel; Parts Family 7301), 16 Pin
Cable Connector (CONINVERS; TU Series), 19 Pin
Female Connector (Binder; 702 Series), 5 Pin

Connecting Cable	
Diameter	10.80 +/- 0.35 mm (0.425 +/- 0.014")

Connecting Cable	
Weight	Approx. 172 g/m
Bending Radius	Once: >/= 5 x Cable Diameter Several Times: >/= 12 x Cable Diameter
UL Approved According to Style 20233, 80 °C (176 °F), 300 V	

Environmental Conditions	
Temperature During Operation	0 °C to 50 °C
Temperature During Storage, Transport	- 25 °C to + 70 °C
Relative Air Humidity for Operation and Storage	10 % to 95 %, Non-Condensing
Application Area	Degree of Pollution 1, Overvoltage Category II

Standards and Guidelines	
Interference Immunity	EN 61000-4-2 EN 61000-4-3 EN 61000-4-4 EN 61000-4-5 EN 61000-4-6 EN 61000-6-2 EN 61000-6-3 Tab. A1
Emitted Interference	EN 55011 Limit Value Class A EN 55022 Limit Value Class A
Equipment Requirements	EN 61131
Storage and Transportation	EN 61131 Part 2
Power Supply	EN 61131 Part 2
Electromagnetic Compatibility	89/336/EEC (Including all Applicable Amendments)
Degrees of Protection	EN 60529
Impact Load, Shocks	EN 60068 Part 2-27
Sinusoidal Vibrations	EN 60068 Part 2-6
Corrosion Protection	IEC 60068

This is a class A device. This device may cause radio interference in residential areas. In this case, the user may be required to introduce appropriate countermeasures, and to bear the cost of same.

Housing	
Type	ROSE Limanda
Material	Polyamide
Seal	CR Round Seal
Impact Resistance	> 7 Nm to DIN 50014
Flammability	V2 to UL94
Degree of Protection	IP65
Total Weight	Approx. 2400 g Without Connecting Cable

7 Ordering Data

Table 7-1 Accessories

Description	Part Number
5 Pin Download Cable	88311.020
USB-RS232 Converter for Downloads (In Connection With 88311.020 Only)	81215.000
Battery, Assembled With Cable And Connector	66694.000
Device Connector (Front Panel Mounting) 16 Pin Insert With Soldering Contacts	57320.000 57323.000
Inclination adapter for mounting to wall or machine Support for housing for mounting to inclination adapter	29541.900 29541.901

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